AIRS Version 7
Level 3 Product User Guide

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April 2020
Version 1.0

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1. Introduction

The purpose of this document is to provide users of Atmospheric Infrared Sounder (AIRS)/Advanced Microwave Sounding Unit (AMSU)/Humidity Sounder for Brazil (HSB) (AIRS for simplicity) Version 7 (V7) Level 3 (L3) products a brief guide how to use the AIRS V7 L3 products in their research and application.

The AIRS L3 products are gridded mean geophysical parameters on 1°x1° latitude/longitude grid cells. Grid map coordinates range from -180.0° to +180.0° in longitude and from -90.0° to +90.0° in latitude. The latitudes and longitudes of the grid cell centers are provided in the data (latitude, longitude). The upper left grid cell center location is (89.5, -179.5) and the lower right grid cell center location is (-89.5, +179.5). The spatial extent of the 1x1 degree grid spans the upper left (+90, -180) to lower right (-90, +180).

The L3 gridded mean products are derived from the AIRS V7 Level 2 (L2) swath products. The L2 quality indicators determine which of the L2 products are combined to create the L3 products. As a general rule, the L2 retrieved quantities whose quality indicators are “best” (0) or “good” (1) are included in the sums that generate the L3 gridded products. For each grid map of mean values there is corresponding maps of count and standard deviation. The count map provides the users with the number of L2 observations per bin that were included in the mean and can be used to generate custom multi-day maps from the daily L3 products. Values of -9999 or a count of 0 indicate invalid or missing data.

1.1. L3 Instrument Combination Variants

Three different combinations of instrument data are used to produce the AIRS L2 data and these result in three different processing sets or variants of L3 products: **AIRS-Only, AIRS+AMSU and AIRS+AMSU+HSB**. The first processing combination uses the data from AIRS instrument only. This AIRS-Only L3 product has lower yield, especially in cloudy regions, but will have a greater continuity and covers the full mission period (from the beginning of the mission August 2002 to the present). The second processing combination uses the data from both AIRS and AMSU instruments. This AIRS+AMSU L3 product has a better accuracy and a higher yield, especially in cloudy regions. It covers from the beginning of the mission August 2002 to September 2016 because of the power failure of AMSU-A2 on 24 September 2016. The third processing combination uses the data from AIRS, AMSU-A and HSB (a variant of AMSU-B) instruments. The AIRS+AMSU+HSB L3 product has the highest yield and the best-quality water vapor and precipitation parameters that are not present in the other processing combination variants (AIRS-Only and AIRS+AMSU) but it is available only for a few months from August 2002 to February 2003 because HSB failed on February 5, 2003, less than a year into the mission.

1.2. L3 Product Types

There are two different types of the AIRS L3 products based on their different vertical resolutions and different user groups: **standard and support products**.

The AIRS L3 **standard** product contains gridded retrieved parameters on the standard pressure levels roughly matching instrument vertical resolution and is designed for use by the general public in their research. Temperature and water vapor profiles are reported on 24 (**TempPresLvls**) or 12 (**H2OPresLvls)** standard pressure levels. Their values (in hPa) are listed in **Table 1** and also provided for convenient reference in the document **V7_L3_Standard_Pressure_Levels.pdf.**

The AIRS L3 **support** product contains gridded interim and experimental portions intended for use by the AIRS team and others willing to make a significant investment of time in understanding the products and is reported at higher internal vertical resolution at 100 pressure levels similar to the AIRS L2 products. The support pressure levels (in hPa) are listed in **Table 2** and also provided for convenient reference in the document **V7_L2_Support_Pressure_Levels.pdf**.

Table 1. AIRS V7 L3 Standard Pressure Levels

Index of Temperature & H2OVapMMR Levels & Layers	Values of Temperature Levels (TempPresLvls) (hPa)	Values of H2OVapMMR Levels (H2OPresLvls) (hPa)	Values of H2OVapMMR Layers (midlayer pressure) (hPa)
1	1000.0	1000.0	961.8
2	925.0	925.0	886.7
3	850.0	850.0	771.4
4	700.0	700.0	648.1
5	600.0	600.0	547.7
6	500.0	500.0	447.2
7	400.0	400.0	346.4
8	300.0	300.0	273.9
9	250.0	250.0	223.6
10	200.0	200.0	173.2
11	150.0	150.0	122.5
12	100.0	100.0	83.7
13	70.0		
14	50.0		
15	30.0		
16	20.0		
17	15.0		
18	10.0		
19	7.0		
20	5.0		
21	3.0		
22	2.0		
23	1.5		
24	1.0		

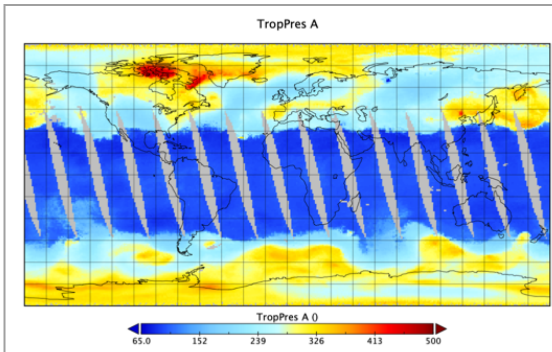
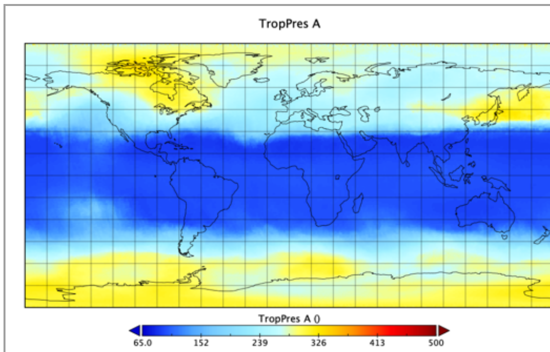
Table 2. AIRS V7 L3 Support Pressure Levels.

Index	pressSup, hPa	Index	pressSup, hPa	Index	pressSup, hPa
1	0.0161	34	47.1882	67	358.966
2	0.0384	35	51.5278	68	374.724
3	0.0769	36	56.1260	69	390.893
4	0.1370	37	60.9895	70	407.474
5	0.2244	38	66.1253	71	424.47
6	0.3454	39	71.5398	72	441.882
7	0.5064	40	77.2396	73	459.712
8	0.714	41	83.2310	74	477.961
9	0.9753	42	89.5204	75	496.63
10	1.2972	43	96.1138	76	515.72
11	1.6872	44	103.017	77	535.232
12	2.1526	45	110.237	78	555.167
13	2.7009	46	117.777	79	575.525
14	3.3398	47	125.646	80	596.306
15	4.077	48	133.846	81	617.511
16	4.9204	49	142.385	82	639.14
17	5.8776	50	151.266	83	661.192
18	6.9567	51	160.496	84	683.667
19	8.1655	52	170.078	85	706.565
20	9.5119	53	180.018	86	729.886
21	11.0038	54	190.32	87	753.628
22	12.6492	55	200.989	88	777.79
23	14.4559	56	212.028	89	802.371
24	16.4318	57	223.441	90	827.371
25	18.5847	58	235.234	91	852.788
26	20.9224	59	247.408	92	878.62
27	23.4526	60	259.969	93	904.866
28	26.1829	61	272.919	94	931.524
29	29.121	62	286.262	95	958.591
30	32.2744	63	300.0	96	986.067
31	35.6505	64	314.137	97	1013.95
32	39.2566	65	328.675	98	1042.23
33	43.1001	66	343.618	99	1070.92
				100	1100.0

1.3. L3 Product Temporal Resolutions

The temporal resolutions of the AIRS L3 products are **daily** and **monthly** (calendar). The daily L3 product can be used to address the high frequency climate variability, such as synoptic weather and intraseasonal variability. The daily L3 product is also used as input to the monthly L3 products. In addition, individual users can easily aggregate daily L3 product into custom multi-day L3 product based on their specific needs. The monthly L3 product is simply the arithmetic mean of the daily L3 product. The monthly L3 product can be used to address the climate trend analysis and low-frequency climate variability. The users of monthly L3 product are typically interested in monthly means over long time scales and prefer data products with the lowest possible systematic errors. The daily L3 product will have gores (cells with no data) between the satellite paths where there is no coverage for that day. The monthly L3 product will likely contain complete global coverage without gores and with missing data only in locations in which the retrieval algorithm found to be problematical or where topography intrudes into the lower altitude regime of profiles. The temporal characteristics of these two L3 data types are summarized in **Table 3**.

Table 3. L3 Product Temporal Resolutions.

Daily	*Monthly*
"Complex" data, leaves in gores between satellite tracks (missing)	"Simple" data, no gores, complete coverage
1°x1° spatial resolution	1°x1° spatial resolution
1-day temporal resolution	Monthly (calendar)
 **Figure 1**. One example of L3 daily tropopause pressure for the ascending node	 **Figure 2**. One example of L3 monthly tropopause pressure for the ascending node

Each L3 daily product contains information for a nominal temporal period of 24 hours for either the descending or ascending orbit rather than from midnight to midnight. The nominal period for the descending orbit is 1:30PM-to-1:30PM UTC (centered at the equator crossing time of 1:30 AM); for the ascending orbit it is 1:30AM-to-1:30AM. The data included in the gridding on a particular day starts at the antimeridian and progress westward (as do the subsequent orbits of the satellite) so that neighboring gridded cells of data are no more than a swath of time apart (about 100 minutes). The two parts of a scan line that crosses the dateline are included in separate data sets, according to the appropriate date. This ensures that data points in a grid box are always coincident in time. If the data were gridded using the midnight-to-midnight time-span, the start of the day and the end of the day could be in the same grid cell, producing an artificial time discontinuity. The edge of the AIRS L3 gridded cells is at the antimeridian (the 180 E/W longitude boundary). When plotted, this produces a map with 0-degree longitude in the center of the image unless the bins are reordered. This method is preferred because the left (West) side of the image and the right (East) side of the image contain data farthest apart in time. Similar contiguous daily L3 maps centered at other longitudes may be created by combining the appropriate parts of two daily L3 files. The gridding scheme used by AIRS is the same as used by TOVS Pathfinder to create L3 products.

1.4. L3 Product Short Names

The short names used to identify AIRS L3 products and their file names according to different instrument combination variants, different vertical resolutions and purposes, and different temporal resolutions are listed in **Table 4**.

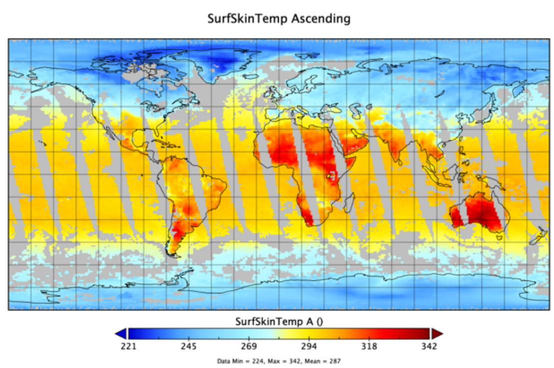
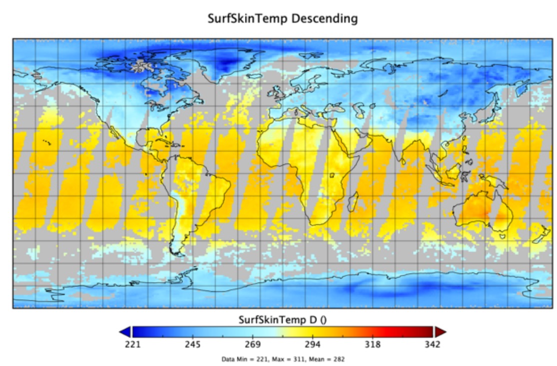
Table 4. Short Names for AIRS V7 L3 Products

	AIRS-Only	
	Daily	Monthly
Standard L3	AIRS3STD	AIRS3STM
Support L3	AIRS3SPD	AIRS3SPM
	AIRS+AMSU	
	Daily	Monthly
Standard L3	AIRX3STD	AIRX3STM
Support L3	AIRX3SPD	AIRX3SPM
	AIRS+AMSU+HSB	
	Daily	Monthly
Standard L3	AIRH3STD	AIRH3STM
Support L3	AIRH3SPD	AIRH3SPM

1.5. L3 Product Nodes

The AIRS L3 products are separated into **ascending and descending** portion of the orbit, where "ascending or descending" refers to the direction of movement of the sub-satellite point in the satellite track. The ascending direction of movement is from the Southern Hemisphere to the Northern Hemisphere, with an equatorial crossing time of 1:30 PM local time; the descending direction of movement is from the Northern Hemisphere to the Southern Hemisphere, with an equatorial crossing time of 1:30 AM local time. Outside of the polar zones, these correspond respectively to daytime and nighttime.

Table 5. Examples of L3 Daily Product for Ascending and Descending Nodes

Ascending (~day)	Descending (~night)
 **Figure 3**. One example of L3 daily surface skin temperature for the ascending node	 **Figure 4**. One example of L3 daily surface skin temperature for the descending node

2. L3 Standard Product

ESDT Short Names= “AIRX3STD”, “AIRX3STM”, “AIRH3STD”, “AIRH3STM”, “AIRS3STD”. “AIRS3STM”

Grid Names = “location”, “ascending”, “descending”, “ascending_TqJoint”, “descending_TqJoint”, “ascending_MW_Only”, “descending_MW_Only”

Horizontal resolution= 1°x1° degree (360x180)

Upper Left Point= -180.0, 90.0

Lower Right Point= 180.0, -90.0

Projection= GCTP_GEO (Global image)

2.1. L3 Standard Product Example File Names

The following examples are L3 standard daily and monthly product files for January 2011.

Daily Product January 1, 2011 processed using only AIRS radiances:
Name: AIRS.2011.01.01.L3.RetStd_IR001.v7.0.2.0.G2002123120634.hdf
Short name: AIRS3STD

Daily Product January 1, 2011 processed using both AIRS and AMSU radiances:
Name: AIRS.2011.01.01.L3.RetStd001.v7.0.2.0.G13010201044.hdf
Short name: AIRX3STD

Daily Product January 1, 2011 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2011.01.01.L3.RetStd_H001.v7.0.2.0.G2002123120634.hdf
Short name: AIRH3STD

Monthly Product January 2011 processed using only AIRS radiances:
Name: AIRS.2011.01.01.L3.RetStd_IR031.v7.0.2.0.G2002123120634.hdf
Shortname: AIRS3STM

Monthly Product January 2011 processed using AIRS and AMSU radiances:
Name: AIRS.2011.01.01.L3.RetStd031.v7.0.2.0.G2002123120634.hdf
Shortname: AIRX3STM

Monthly Product January 2011 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2011.01.01.L3.RetStd_H031.v7.0.2.0.G2002123120634.hdf

Shortname: AIRH3STM

2.2. L3 Standard Product Grids

Each L3 standard product (daily and monthly) contains 6 HDF-EOS grids with fields created using the appropriate L2 products whose quality indicators are "best" (0) or "good" (1). Each grid includes data for the entire globe in 360 x 180 grid cells each 1 x 1 degree of latitude/longitude. These grids are named "ascending_MW_Only", "descending_MW_Only", "ascending", "descending", "ascending_TqJoint", and "descending_TqJoint". The first pair are created from the L2 MW-Only products. The second pair are created from the L2 AIRS-Only or AIRS+AMSU products. For the "ascending_MW_Only", "descending_MW_Only", ascending, and descending grids, L2 quality control per field is used (*_QC) collecting all observations where quality level is 0 (best) or 1 (good). This ensures that these grids have the most complete set of data available for each field and level, but the use of different ensembles for different data fields can complicate comparisons across fields or levels. The third pair are created from the L2 AIRS-Only or AIRS+AMSU products using a single, unified L2 quality control criterion for all fields, TSurfAir_QC must be 0 or 1. This ensures that all data fields have the same ensembles for comparisons across fields or levels.

The separation into ascending and descending portions of the orbit mitigates the suppression of the diurnal signal in the data. Ascending field names have a suffix "_A" appended. Descending field names have a suffix "_D" appended.

Each grid provides a 360x180xn array of standard retrieval mean (without any suffix) as well as input count (with a suffix of _ct) and standard deviation (with a suffix of _sdev). The "extra dimension" n=24 for temperature and n=12 for water vapor and n=1 if the product is not a profile. The inclusion of input count allows the users to create custom L3 products over any desired time span via a simple combination of the published daily L3 products.

Each grid also provides a 360x180 array of total count of observations, whether included in the calculation of the L3 product or not. This can be used with a field's input count to provide a measure of the sampling of a reported L3 product, but not of the sampling bias.

Grid name	Tag	Description
location	None	Location information which is valid for all grids
ascending	_A	Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) Each field and level is individually quality controlled.

descending	_D	Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) Each field and level is individually quality controlled.
ascending_TqJoint	_TqJ_A	Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.) Collective quality control is used across all fields and levels.
descending_TqJoint	_TqJ_D	Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.) Collective quality control is used across all fields and levels.
ascending_MW_Only	_MW_A	Microwave information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.)
descending_MW_Only	_MW_D	Microwave information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.)

These dimensions appear in selected grids as needed.

Name	Grids	Size: Values	Explanation
StdPressureLev	ascending, descending, ascending_TqJoint, descending_TqJoint, ascending_MW_Only, descending_MW_Only	24: 1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30, 20, 15, 10, 7, 5, 3, 2, 1.5, 1 hPa	Pressure levels of temperature and trace gas profiles and geopotential height. The array order is from the surface upward, in conformance with WMO standard. Note that the L3 pressure levels are a subset of the 28 L2 pressure levels, restricted to the range of [1.0, 1000.0] hPa.
H2OPressureLev	ascending, descending, ascending_TqJoint, descending_TqJoint	12: 1000, 925, 850, 700, 600, 500, 400, 300, 250, 200, 150, 100 hPa	Pressure levels of water vapor level profiles.
H2OPressureLay	ascending, descending,	12: 961.8, 886.7 771.4, 648.1,	Midpoints of pressure layers of water vapor layer profiles. Layer

	ascending_TqJoint, descending_TqJoint	547.7, 447.2, 346.4, 273.9, 223.6, 173.2, 122.5, 83.7 hPa	boundaries are at StdPressureLev.
EmisFreqIR	ascending, descending, ascending_TqJoint, descending_TqJoint	4: 832, 961, 1203, 2616 cm^{-1}	Frequencies corresponding to each of the 4 IR emissivity values reported in the AIRS L3 Standard Product.
EmisFreqMW	ascending_MW_Only, descending_MW_Only	3: 23.0, 50.3, 89.0 GHz	Frequencies corresponding to each of the 3 microwave emissivity values reported in the AIRS L3 Standard Product.
CoarseCloudLayer	ascending, descending, ascending_TqJoint, descending_TqJoint	3: 865, 547, 66 hPa	Mid-layer pressures of the 3 coarse cloud layers. Layer boundaries are at {1100., 680., 440., 10.} hPa
FineCloudLayer	ascending, descending, ascending_TqJoint, descending_TqJoint	12: 1018, 887, 771, 648, 548, 447, 346, 274, 224, 173, 122, 32 hPa	Mid-layer pressures of the 12 fine cloud layers. Layer boundaries are at {1100., 925., 850., 700., 600, 500, 400, 300, 250, 200, 150, 100, 10} hPa
XDim	location, ascending, descending, ascending_TqJoint, descending_TqJoint, ascending_MW_Only, descending_MW_Only	360: -179.5, -178.5, …, 178.5, 179.5	West to East dimension for all grids. Long_name “Longitude”. Values are mid-cell longitude.
YDim	location, ascending, descending, ascending_TqJoint, descending_TqJoint, ascending_MW_Only, descending_MW_Only	180: -89.5, -88.5, …, 88.5, 89.5	South to North dimension for all grids. Long_name “Latitude”. Values are mid-cell latitude.

2.3. L3 Standard Product Location Grid Fields

The location grid contains 4 geolocation fields each of which is a 360x180 element array. The elements provide the location and characteristics of the grid cells:

Name	Type	Extra Dimensions	Explanation
Latitude	32-bit floating-point	None	Array of 360 x 180 latitude values at the center of the grid box (Degrees).
Longitude	32-bit floating-point	None	Array of 360 x 180 longitude values at the center of the grid box (Degrees).
LandSeaMask	16-bit integer	None	Land sea mask. 1 = land, 0 = ocean. (Unitless). (Up through V5 this data was used to exclude land profiles from grid squares marked sea and vice versa. As of v6 this is not done, but the field is retained for user convenience.)
Topography	32-bit floating-point	None	Topography of the Earth in meters above the geoid. Original data source: PGS Toolkit

2.4. L3 Standard Product Attributes

These fields appear once per L3 file as HDF-EOS grid attributes in the location grid. They apply to the entire file. The attributes with extra dimensions are provided in this format for backwards compatibility, but the same information is provided in identically named dimensions with associated dimension scales in the grids where these dimensions are used.

Name	Type	Extra Dimensions	Explanation
Year	32-bit integer	None	Year at start of nominal data period
Month	32-bit integer	None	Month at start of nominal data period [1,12]
Day	2-bit integer	None	Day of month at start of nominal data period [1,31]
NumOfDays	32-bit integer	None	Total number of days of input L2 data included in gridded maps.
AscendingGridStartTimeUTC	String of 8-bit characters	None	Begin time of mapped fields (UTC), ascending.
AscendingGridEndTimeUTC	String of 8-bit characters	None	End time of mapped fields (UTC), ascending.
DescendingGridStartTimeUTC	String of 8-bit characters	None	Begin time of mapped fields (UTC), descending.

DescendingGridEndTimeUTC	String of 8-bit characters	None	End time of mapped fields (UTC), descending.
StdPressureLev	32-bit floating point	StdPressureLev (24)	Pressure levels of temperature profiles and geopotential height. The array order is from the surface upward, in conformance with WMO standard. Note that the L3 pressure levels are a subset of L2 pressure levels and are constrained to begin at 1000.0 mb and end at 1.0 mb.
H2OPressureLev	32-bit floating point	H2OPressureLev (12)	Pressure levels of water vapor level profiles.
H2OPressureLay	32-bit floating point	H2OPressureLay (12)	Midpoints of pressure layers of water vapor layer profiles.
EmisFreqIR	32-bit floating point	EmisFreqIR (4)	Frequencies corresponding to each of the 4 IR emissivity values reported in the AIRS L3 Standard Product. (832.0, 961.0, 1203.0, 2616.0 cm-1)
EmisFreqMW	32-bit floating point	EmisFreqMW (3)	Frequencies corresponding to each of the 3 microwave emissivity values reported in the AIRS L3 Standard Product. (23.0, 50.3, and 89.0 GHz)
CoarseCloudLayer	32-bit floating point	CoarseCloudLayer (3)	Midlayer pressures of the 3 coarse cloud layers
FineCloudLayer	32-bit floating point	FineCloudLayer (12)	Midlayer pressures of the 12 fine cloud layers

2.5. L3 Standard Product Grid Fields

These fields appear once per grid. Tags from the grid table are appended so that the final field names are unique across all the grids in each file. For example, the field with the base name “Temperature” will appear as “Temperature_A” in the ascending grid and “Temperature_TqJ_D” in the descending_TqJoint grid. Quantities for which L2 provides one retrieved value per field of regard (FOR) (3x3 AIRS fields of view (FOVs)) are recorded for each of the associated 9 AIRS FOV latitudes and longitudes. The value in the field is the mean over all observations that fell in the grid cell and passed quality control. There are also two ancillary fields for each field: _ct is a 16-bit count of the number of L2 observations used in the L3 grid mean. It can be ratioed with TotalCounts to give a yield. _sdev is a 32-bit standard deviation of the observations in this L3 grid cell. They are present for all floating-point fields. For example, in the ascending grid the main (mean) Temperature field is "Temperature_A" and it has ancillary fields "Temperature_A_ct" and "Temperature_A_sdev".

2.5.1. Standard and TqJoint Grid Fields

Base Name	Type	Extra Dimensions	Explanation
TotalCounts	16-bit integer	None	Total counts of all AIRS FORs that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations. Note that in V6 this was the number of AMSU FOVs, a factor of 9 times large.
SurfPres_Forecast	32-bit floating point	None	Surface pressure from forecast. (hPa)
SurfSkinTemp	32-bit floating point	None	Surface skin temperature. (Kelvin)
EmisIR	32-bit floating point	EmisFreqIR (4)	IR surface emissivity at frequencies {832, 961, 1203, 2616} cm^{-1}
Temperature	32-bit floating point	StdPressureLev (24)	Atmospheric temperature (Kelvin)
SurfAirTemp	32-bit floating point	None	Temperature of the atmosphere at the Earth's surface. (Kelvin)
TropPres	32-bit floating point	None	Pressure of the tropopause. (hPa)
TropTemp	32-bit floating point	None	Temperature of the tropopause. (Kelvin)
TotH2OVap	32-bit floating point	None	Total integrated column water vapor burden. (kg/m^2)
H2O_MMR_Lyr	32-bit floating point	H2OPressureLay (12)	Water vapor mass mixing ratio averaged over each of standard pressure layers (g/kg dry air)
H2O_MMR	32-bit floating point	H2OPressureLev (12)	Water vapor mass mixing ratio at standard pressure levels (g/kg dry air)
H2O_MMR_Surf	32-bit floating point	None	Water vapor mass mixing ratio at the surface (g/kg dry air)
RelHum	32-bit floating point	H2OPressureLev (12)	Relative humidity over equilibrium phase (Percent)

RelHumSurf	32-bit floating point	None	Relative humidity at the surface over equilibrium phase (Percent)
RelHum_liquid	32-bit floating point	H2OPressureLev (12)	Relative humidity over liquid phase (Percent)
RelHumSurf_liquid	32-bit floating point	None	Relative humidity at the surface over liquid phase (Percent)
TropHeight	32-bit floating point	None	Height of the tropopause. (meters)
GPHeight	32-bit floating point	StdPressureLev (24)	Geopotential height. (Meters)
CloudFrc	32-bit floating point	None	Combined layer cloud fraction. (0-1). (Unitless)
CloudTopPres	32-bit floating point	None	Combined cloud top pressure (weighted by cloud fraction). (hPa)
CloudTopTemp	32-bit floating point	None	Combined cloud top temperature (weighted by cloud fraction). (Kelvin)
FineCloudFrc	32-bit floating point	FineCloudLayer (12)	Cloud fraction at fine cloud resolution (Unitless)
CoarseCloudFrc	32-bit floating point	CoarseCloudLayer (3)	Cloud fraction at coarse cloud resolution. 3 layers: low, middle, high. (Unitless)
CoarseCloudPres	32-bit floating point	CoarseCloudLayer (3)	Cloud layer pressure at coarse cloud resolution. 3 layers: low, middle, high. (hPa)
CoarseCloudTemp	32-bit floating point	CoarseCloudLayer (3)	Cloud layer cloud top temperature at coarse cloud resolution. 3 layers: low, middle, high. (Kelvin)
TotO3	32-bit floating point	None	Total integrated column ozone burden. (Dobson units)
O3_VMR	32-bit floating point	StdPressureLev (24)	Ozone volume mixing ratio (unitless)
CO_VMR	32-bit floating point	StdPressureLev (24)	CO volume mixing ratio. (unitless)
CH4_VMR	32-bit floating point	StdPressureLev (24)	CH4 volume mixing ratio. (unitless)
OLR	32-bit floating point	None	Outgoing long-wave radiation flux. (watts/m^2)
ClrOLR	32-bit floating point	None	Clear-sky outgoing long-wave radiation flux. (watts/m^2)

2.5.2. MW-Only Grid Fields

The Microwave-Only (MW-Only) grid products are retrieved by the MW retrieval stage of the AIRS algorithm. No IR data are used to retrieve these products. All other products described later in this document are retrieved employing the combined IR/MW retrieval stages of the AIRS algorithm, providing greater vertical resolution of temperature and water vapor fields, improved surface emissivity and retrievals of atmospheric constituents.

Base Name	Type	Extra Dimensions	Explanation
TotalCounts	16-bit integer	None	Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations.
Emis	32-bit floating point	EmisFreqMW (3)	Microwave spectral emissivity at frequencies {23.8, 50.3 and 89.0} GHz.
Temperature	32-bit floating point	StdPressureLev (24)	Microwave-only atmospheric temperature (Kelvin)
TotH2OVap	32-bit floating point	None	Total integrated column water vapor burden. (kg/m^2)
GPHeight	32-bit floating point	StdPressureLev (24)	Microwave-only geopotential height (meter)
TotCldLiqH2O	32-bit floating point	None	Total integrated column cloud liquid water. (kg/m^2)

3. L3 Support Product

ESDT Short Names= “AIRX3SPD”, “AIRX3SPM”, “AIRH3SPD”, “AIRH3SPM”, “AIRS3SPD”. “AIRS3SPM”
Grid Names = “location”, “ascending”, “descending”
Horizontal resolution= 1°x1° degree (360x180)
Upper Left Point= -180.0, 90.0
Lower Right Point= 180.0, -90.0
Projection= GCTP_GEO (Global image)

The L3 support products are similar to the L3 standard products but contain fields that are either the full 100 levels; not fully validated; or are inputs or intermediary values. Because no quality control information is available for some of these fields, values from failed retrievals may be included. The temporal resolution of the AIRS L3 support products is same as that for the L3 standard products: **daily** and **monthly** (calendar).

3.1. L3 Support Product Example File Names

The following examples are L3 support daily and monthly product files for January 2011.

Daily Product January 1, 2011 processed using only AIRS radiances:
Name: AIRS.2011.01.01.L3.RetSup_IR001.v7.0.2.0.G2002123120634.hdf
Shortname: AIRS3SPD

Daily Product January 1, 2011 processed using AIRS and AMSU radiances:
Name: AIRS.2011.01.01.L3.RetSup001.v7.0.2.0.T13010201044.hdf
Shortname: AIRX3SPD

Daily Product January 1, 2011 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2011.01.01.L3.RetSup_H001.v7.0.2.0.G2002123120634.hdf
Shortname: AIRH3SPD

Monthly Product January 2011 processed using only AIRS radiances:
Name: AIRS.2011.01.01.L3.RetSup_IR031.v7.0.2.0.G2002123120634.hdf
Shortname: AIRS3SPM

Monthly Product January 2011 processed using AIRS and AMSU radiances:

Name: AIRS.2011.01.01.L3.RetSup031.v7.0.2.0.G2002123120634.hdf
Shortname: AIRX3SPM

Monthly Product January 2011 processed using AIRS, AMSU, HSB radiances:
Name: AIRS.2011.01.01.L3.RetSup_H031.v7.0.2.0.G2002123120634.hdf
Shortname: AIRH3SPM

3.2. L3 Support Product Grids

The data in the L3 support product is contained in 3 HDF-EOS Grids. Each grid includes data for the entire globe in 360 x 180 grid cells each 1 x 1 degree of latitude/longitude. Most fields appear in the two main grids: ascending and descending.

Grid name	Tag	Description
location	None	Location information which is valid for all grids
ascending	_A	Information collected while the spacecraft is in the ascending part of its orbit. (Daytime data except near the poles.)
descending	_D	Information collected while the spacecraft is in the descending part of its orbit. (Nighttime data except near the poles.)

These dimensions appear in selected grids as needed.

Name	Grids	Size: Values	Explanation
XtraPressureLev	ascending, descending	100	Pressure levels of internal 100-level temperature profiles. hPa.
XtraPressureLay	ascending, descending	100	Pressure layers of internal 100-layer gas profiles. hPa.
SurfClass	ascending, descending	8: 0="coastline (Liquid water covers 50-99% of area)", 1= "land (Liquid water covers < 50% of area)", 2="ocean (Liquid water covers > 99% of area)", 3="sea ice (High MW emissivity)", 4="sea ice (Low MW emissivity)", 5="snow (Higher-frequency MW scattering)", 6="glacier/snow (Very low-frequency MW scattering)", 7= "snow (Lower-frequency MW scattering)"	Surface Classes counted in SurfClass_Count
DustTest	ascending, descending	9: 1, 2, 4, 8, 16, 32, 64, 128, 256	Dust Tests counted in Dust_Score. Least significant to most significant.

MODISEmis10Hinge	ascending, descending	10: 699.30, 826.45, 925.93, 1075.27 1204.82, 1315.79, 1724.14, 2000.00, 2325.58, 2777.78	MODIS emissivity hinge points
SpectralOlr	ascending, descending	16: Band Spectral Interval (cm-1) 1 100 – 350 2 350 – 500 3 500 – 630 4 630 – 700 5 700 – 820 6 820 – 980 7 980 – 1080 8 1080–1180 9 1180–1390 10 1390–1480 11 1480–1800 12 1800–2080 13 2080–2250 14 2250–2380 15 2380–2600 16 2600–3260	Frequency bands on which spectralolr and spectralclrolr are reported
CloudPhase	ascending, descending	7: liquid (high confidence), liquid (low confidence), unknown, ice (low confidence), ice (medium confidence), ice (high confidence), ice (very high confidence)	Cloud phases used in cloud_phase_3x3
SpectralClr	ascending, descending	5: "Ocean test applied and scene identified as clear", "Ocean test applied and scene not identified as clear", "Calculation could not be completed. Possibly some inputs were missing or FOV is on coast or on the edge of a scan or granule", "Unvalidated land test applied and scene not identified as clear", "Unvalidated land test applied and scene identified as clear"	Categories used in Spectral_Clear_Counts
XDim	location, ascending, descending	360: -179.5, -178.5, … 178.5, 179.5	West to East dimension for all grids. Long_name "Longitude". Values are mid-cell longitude.
YDim	location, ascending, descending	180: -89.5, -88.5, … 88.5, 89.5	South to North dimension for all grids. Long_name "Latitude". Values are mid-cell latitude.

3.3. L3 Support Product Location Grid Fields

These fields are within the location grid and document pertinent information for determining the location and characteristics of a given grid cell for all grids.

Name	Type	Extra Dimensions	Explanation
Latitude	32-bit floating-point	None	Array of 360 x 180 latitude values at the center of the grid box (Degrees).
Longitude	32-bit floating-point	None	Array of 360 x 180 longitude values at the center of the grid box (Degrees).
LandSeaMask	16-bit integer	None	Land sea mask. 1 = land, 0 = ocean. (Unitless). (Up through V5 this data was used to exclude land profiles from grid squares marked sean and vice versa. As of v6 this is not done, but the field is retained for user convenience.)
Topography	32-bit floating-point	None	Topography of the Earth in meters above the geoid. Original data source: PGS Toolkit

3.4. L3 Support Product Attributes

These fields appear once per L3 file as HDF-EOS grid attributes in the location grid. They apply to the entire file. The attributes with extra dimensions are provided in this format for backwards compatibility, but the same information is provided in identically named dimensions with associated dimension scales in the grids where these dimensions are used.

Name	Type	Extra Dimensions	Explanation
Year	32-bit integer	None	Year at start of nominal data period
Month	32-bit integer	None	Month at start of nominal data period [1,12]
Day	2-bit integer	None	Day of month at start of nominal data period [1,31]
NumOfDays	32-bit integer	None	Total number of days of input L2 data included in gridded maps.
AscendingGridStartTimeUTC	String of 8-bit characters	None	Begin time of mapped fields (UTC), ascending.
AscendingGridEndTimeUTC	String of 8-bit characters	None	End time of mapped fields (UTC), ascending.
DescendingGridStartTimeUTC	String of 8-bit characters	None	Begin time of mapped fields (UTC), descending.
DescendingGridEndTimeUTC	String of 8-bit	None	End time of mapped fields

	characters		(UTC), descending.
SurfClass	16-bit integer	SurfClass (8)	Surface Classes counted in SurfClass_Count
DustTest	16-bit integer	DustTest (9)	Dust Tests counted in Dust_Score
SpectralOlr	16-bit integer	SpectralOlr (16)	Frequency bands on which spectralolr and spectralclrolr are reported
CloudPhase	16-bit integer	CloudPhase (4)	Cloud phases used in cloud_phase_3x3
SpectralClr	16-bit integer	SpectralClr (5)	Categories used in Spectral_Clear_Counts
MODISEmis10Hinge	32-bit float	MODISEmis10Hinge (10)	10 MODIS emissivity hinge points
XtraPressureLev	32-bit float	XtraPressureLev (100)	100 pressure levels for internal temperature profiles
XtraPressureLay	32-bit float	XtraPressureLay (100)	100 pressure layer for internal gas profiles

3.5. L3 Support Product Grid Fields

These fields appear once per grid. Tags from the grid table are appended so that the final field names are unique across all the grids in each file. For example, the carbon monoxide molecule number density field with the base name “COCDSup” will appear as “COCDSup_A” in the ascending grid and “COCDSup_D” in the descending grid. The value in the main field is the mean over all observations which fell in the grid cell and passed quality control. Quantities for which L2 provides just one retrieved value per FOR (3x3 AIRS FOVs) are recorded for each of the 9 AIRS FOV center locations.

There are also two ancillary fields for each field: _ct is a 16-bit count of the number of L2 observations used in the L3 grid mean. It can be ratioed with TotalCounts to give a yield. _sdev is a 32-bit standard deviation of the observations in this L3 grid cell. They are present for all floating-point fields. For example, in the ascending grid the main (mean) COCDSup field is “COCDSup_A” and it has ancillary fields “COCDSup_A_ct” and “COCDSup_A_sdev”.

Base Name	**Type**	**Extra Dimensions**	**Explanation**
TotalCounts	16-bit integer	None	Total counts of all points that fell within a 1°x1° grid cell whether they were included in the final L3 product or not. Used for yield calculations.

Dust_Score	32-bit floating point	DustTest (9)	Fraction of obs with each dust test triggered. [0.0, 1.0]
SO2_Indicator	32-bit floating point	None	Brightness temperature difference Tb(1361.44 cm-1) - Tb(1433.06 cm-1) used as an indicator of SO2 release from volcanoes. Values under -6 K have likely volcanic SO2. (L2 BT_diff_SO2) (Kelvins)
TAirSup	32-bit floating point	XtraPressureLev (100)	Atmospheric temperature (Kelvin)
Temp_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of temperature (unitless)
H2OCDSup	32-bit floating point	XtraPressureLay (100)	Water vapor layer column density (molecules/cm^2)
H2O_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of water vapor (unitless)
bndry_lyr_top	32-bit floating point	None	Pressure at top of planetary boundary layer (hPa)
cloud_phase_3x3	32-bit floating point	CloudPhase (7)	Counts of observations with each of the 7 possible cloud phase values. Use with TotalCounts to get fraction of obs with any given type.
ice_cld_opt_dpth	32-bit floating point	None	Ice cloud optical depth (unitless)
ice_cld_eff_diam	32-bit floating point	None	Ice cloud effective diameter (microns)
ice_cld_temp_eff	32-bit floating point	None	Ice cloud effective cloud top temperature (Kelvin)
ice_cld_fit_reduced_chisq	32-bit floating point	None	Normalized chi-square residual of the obs-calc radiance residual in the ice cloud optical properties calculation
O3CDSup	32-bit floating point	XtraPressureLay (100)	Ozone layer column density (molecules/cm^2)
O3_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of ozone (unitless)
COCDSup	32-bit floating point	XtraPressureLay (100)	Carbon monoxide layer column density (molecules/cm^2)
CO_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of carbon monoxide (unitless)
CH4CDSup	32-bit floating point	XtraPressureLay (100)	Methane layer column density (molecules/cm^2)

CH4_dof	32-bit floating point	None	Degrees of freedom from the physical retrieval of methane (unitless)
spectralolr	32-bit floating point	SpectralOLR (16)	Outgoing longwave radiation flux integrated over 16 frequency bands (Watts/meter^2)
spectralclrolr	32-bit floating point	SpectralOLR (16)	Clear-sky Outgoing longwave radiation flux integrated over 16 frequency bands (Watts/meter^2)
SurfClass_Count	16-bit integer	SurfClass (7)	Count of cases with each surface type.
IR_Precip_Est	32-bit floating point	None	Regression-based estimate of daily precipitation based on clouds and relative humidity from L2 IR/MW retrieval. Analogous to and forms a continuous record when used with TOVS precipitation index. (per 45 km AMSU-A FOV) (mm/day)
MWSST	32-bit floating point	None	Effective surface skin temperature from MW-Only retrieval step. BT / emis @ 23.8 GHz. (Kelvin)
MW_Emis_24GHz	32-bit floating point	None	MW emissivity @ 23.8 GHz (unitless)
MW_Emis_31GHz	32-bit floating point	None	MW emissivity @ 31.4 GHz (unitless)
MW_Emis_50GHz	32-bit floating point	None	MW emissivity @ 50.3 GHz (unitless)
MW_Emis_89GHz	32-bit floating point	None	MW emissivity @ 89.0 GHz (unitless)
SurfSkinTemp_Forecast	32-bit floating point	None	Predicted surface temperature interpolated from NOAA NCEP GFS forecast (K)
MODIS_LST	32-bit floating point	None	Climatology land surface temperature from MODIS averaged over MYD11C3 0.05 degree (~5 km) pixels covering an area roughly corresponding to an AMSU FOV or 3x3 of AIRS FOVs. Not used in AIRS retrieval but provided for user convenience.
MODIS_emis_10_hinge	32-bit floating-point	MODISEmis10Hinge (= 10)	First guess emissivity from MODIS MYD11C3 at 10 hinge points
Strato_CCI	32-bit floating-point	None	A Stratospheric Coarse Climate Indicator representing the weighted average of retrieved temperatures over the lower

			stratosphere (maximum weight near 70 hPa). The weighting is done in such a manner as to make the weighted temperatures roughly correspond to those given by the MSU4 products in the Spencer and Christy temperature data set, as well as in the TOVS Pathfinder Path A data set (K)
Tropo_CCI	32-bit floating-point	None	A Tropospheric Coarse Climate Indicator representing the weighted average of retrieved temperatures over the lower troposphere (maximum weight near 700 hPa). The weighting is done in such a manner as to make the weighted temperatures roughly correspond to those given by the MSU2R products in the Spencer and Christy temperature data set, as well as in the TOVS Pathfinder Path A data set (K)
Spectral_Clear_Counts	16-bit integer	SpectralClr (=5)	Counts of cases found for each value of spectral_clear_indicator

4. Disclaimers and Caveats for V7 L3 Product

The users should be aware of the following disclaimers and caveats of the AIRS V7 L3 products before they use the products. The users are also advised to read the **V7_L2_Product_User_Guide.pdf**, which is organized by geophysical products with a subsection listing caveats for most of the products.

4.1. Unequal Numbers of Samples within Profiles and among Parameters for L3 Standard Grid Products

Analyses which depend upon correlations between temperature and water vapor fields or correlations of temperature or water vapor between different pressure levels should always use TqJoint grids that contain data for a common set of observations across water vapor and temperature at all atmospheric levels instead of the ascending and descending grids.

For the ascending and descending grids (and ascending_MW_Only and descending_MW_Only grids), L2 quality control per field is used (*_QC) collecting all observations where quality level is 0 (best) or 1 (good). In all cases, a sample is included if the applied quality indicators are either "best" (quality indicator = 0) or "good" (quality indicator = 1). Please refer to the document **V7_L2_Quality_Control_and_Error_Estimation.pdf** for a complete description of the L2 quality indicators. Quality control is applied to each data point entering the gridding algorithm both for different parameters and at different levels in the atmosphere for a profile. This ensures that these grids have the most complete set of data available for each field and level. However, the ensemble of samples combined to create the averages varies between parameters and levels in the atmosphere and this can complicate comparisons across fields or levels. For example, there will be a greater number of samples (greater yield) included in the TAirStd profiles at higher altitudes than those at lower altitudes. Surface fields are filtered using their individual *_QC, which are generally the most restrictive of the quality indicators.

We provide the count of samples, but this does not characterize sampling biases, which result from the retrieval algorithm. For example, parameters that are correlated with cloudiness, e.g. cloud properties and water vapor mass mixing ratio, have sampling biases different from those of the air temperature profile or of the surface parameters. The problem is complicated because the bias is height and species dependent within a grid box. The loss of sensitivity from clouds is not only dependent upon cloud amount, but also dependent upon correlations between clouds at different levels that are not characterized by cloud amount alone. Thus, you cannot use total cloudiness in a grid box to further quality control the products.

4.2. Unequal Numbers of Samples within Profiles due to Topography

Binning vertical profile data over a spatial area containing topography is always problematical. Some samples in a bin may cover a footprint of low altitude topography while others in the same bin may cover a footprint of high altitude topography. This affects the number of samples as a function of altitude of the temperature profile. For example, the number samples falling within an ascending grid, TotalCounts_A, is the maximum number of entries which may be used in determining the average air temperature, Temperature_A, as some point in the vertical profile. Over topography, the count of samples actually included in the calculation at a particular level, Temperature_A_ct, may drop rapidly to zero as the profile approaches the 1000mb level due to intervening topography.

4.3. Digitization Effect due to Compression by Rounding

A user who combines data over a time interval to create a histogram of the number of occurrences of a given value of water vapor in the 500-600mb layer will see a high-frequency oscillation. This is a digitization effect due to the compression of the L3 data by rounding to shrink the product file size. The precision of H2OMMR is 11 bits in the mantissa. This is equivalent to 3 1/2 significant digits. The effective bin size is ~1/2048 of whatever the value is for the given cell. The user has two options to avoid creating a histogram that shows this beating. The first is to make the histogram bin size much larger than the effective bin size. The second is to make the histogram bin size much smaller, but then only display the non-empty bins.

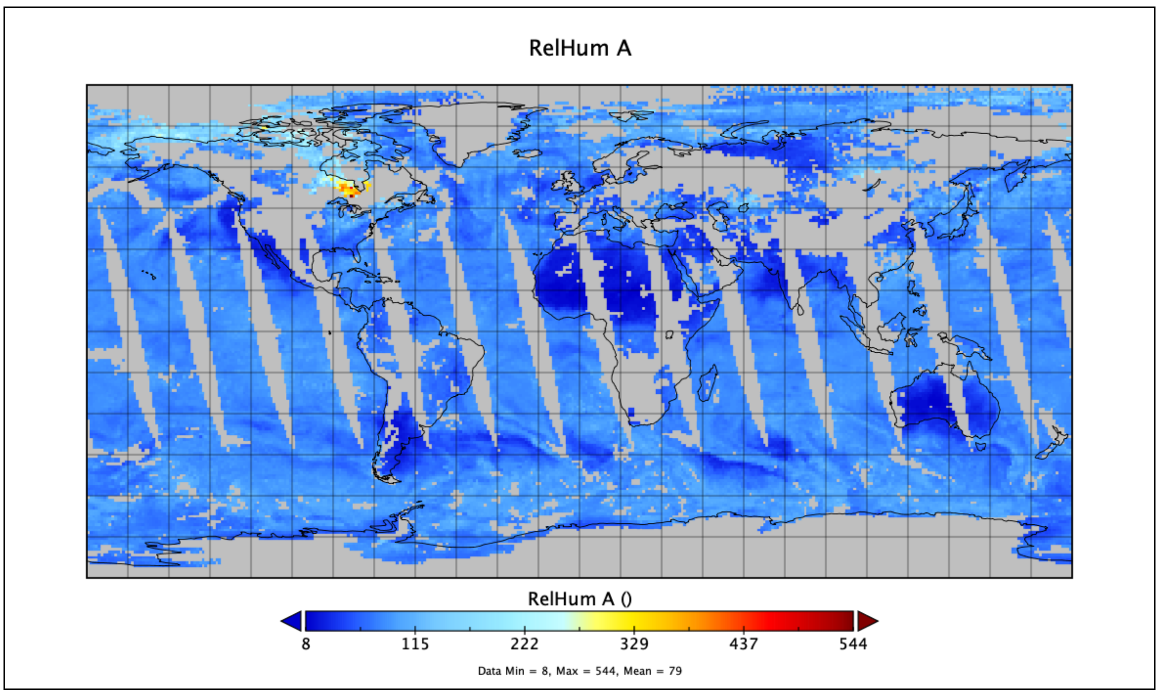
4.4. Difference between TotH2OVap and the Vertical Integral of H2OVapMMR

The L3 layer H2OVapMMR profiles assume the atmosphere extends downward all the way to 1000mb and it can extend below the surface. The L3 total water vapor TotH2Vap values do not make this assumption. The user can partially correct for this by using topography to remove from sums of H2OVapMMR layers and fractions of layers that are below the surface. Unfortunately, specific humidity is not constant throughout the vertical extent of a layer so the correction cannot be exact. This difference can happen over both land and ocean. If the ocean surface pressure is less than 1000 hPa, the bottom layer should appear to have more water vapor than is really there because it will extend below the surface.

4.5. High Relative Humidity in Regions and Levels When Specific Humidity is Very Low

Most values of the atmospheric relative humidity (RelHum) are within 0 and 100%. The supersaturation with the relative humidity is greater than 100% is also common, especially in the upper troposphere and lower stratosphere (UTLS). Thus, the range of AIRS V7 L3 RelHum is 0 and ~200%. However, some RelHum values can exceed 200% or be as large as 500%. These values are typically associated with very low specific humidity or cold temperature and the AIRS instruments have trouble to accurately retrieve humidity. Thus, these high RelHum values are unrealistic and should be excluded in the research.

The following figures show an example of such high RelHum values over the Canada between the Great Lakes and Hudson Bay at 925 hPa for the ascending node at January 22, 2011 based on the AIRS-Only retrievals. Over this region and at this level, the RelHum is over 200%, the temperature is around 245 K (very cold), and the specific humidity is around 0.1 g/kg (very dry).



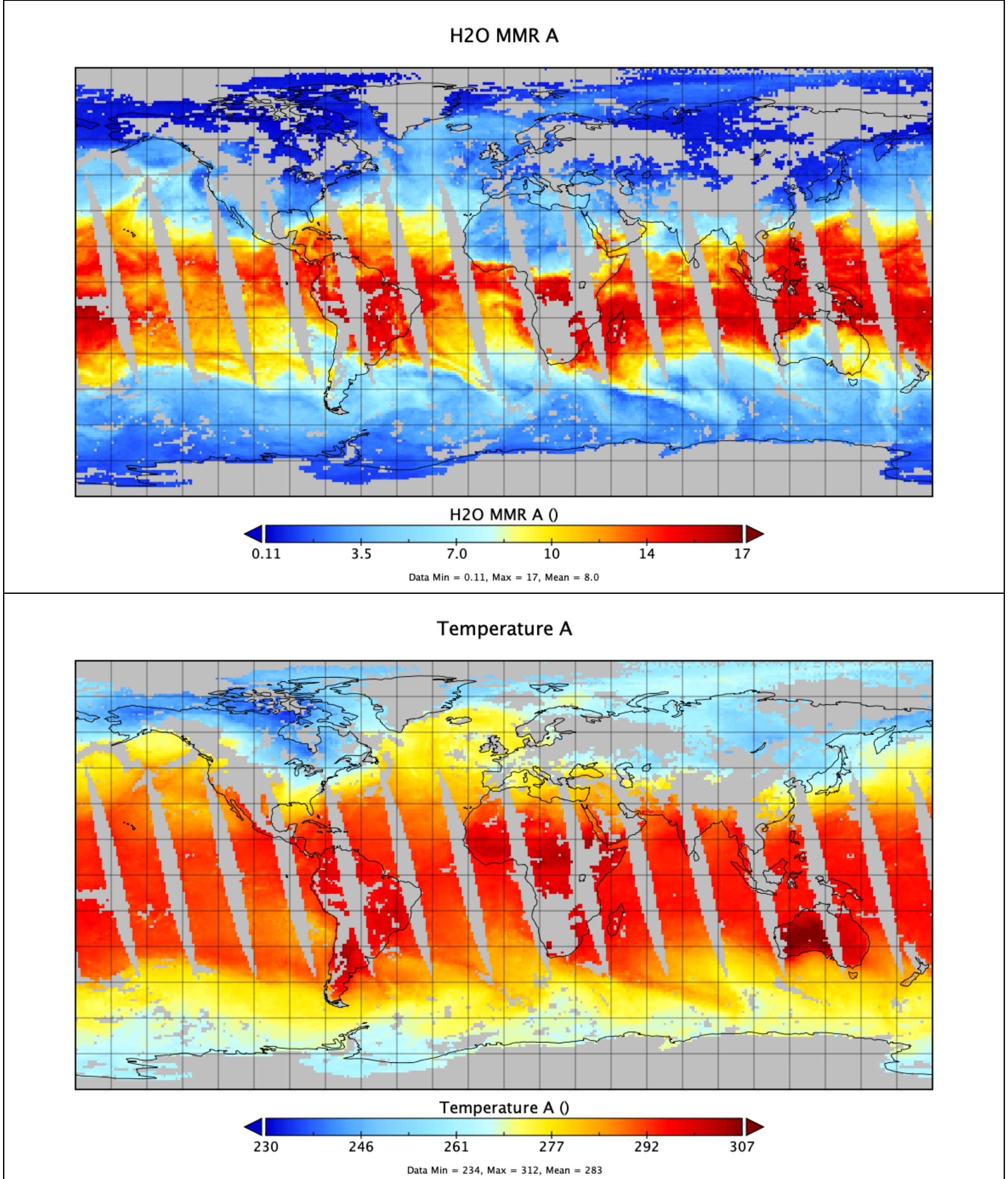


Figure 5. The AIRS V7 L3 standard AIRS-Only ascending relative humidity, specific humidity, and temperature at 925 hPa for January 22, 2011

5. Major Changes for V7 in Comparison to V6

There are four major new improvements or changes for the AIRS V7 L3 products in comparison to the AIRS Version 6 (V6) L3 products.

5.1. Change the Monthly Averaging Method

The AIRS V6 L3 monthly product is generated by the “Averaged By Observation” (ABO) approach. However, the AIRS V7 L3 monthly product is generated by the “Averaged By Day” (ABD) approach. The ABO approach is a “weighted” average of daily means, where the counts of successful retrievals in a 1 × 1 degree grid cell for each day serve as weights. The days with more valid counts have more weights in the monthly average. The day-to-day variations of valid counts arise from the orbit shift and retrieval algorithm. Since the AIRS retrieval fails in conditions with cloud cover more than 70%, the counts will consistently weigh in favor of less-cloudy conditions and cause sampling bias in the V6 L3 standard monthly product. The sampling bias may become more significant and consistent in multi-year climatological estimates. To alleviate this skewed sampling, the ABD approach is to derive the monthly averages from the daily means, without regard to the counts of observations.

Figure 6 shows the AIRS L3 monthly mean temperature at 500 hPa for September 2002 from the standard V6 L3 products based on the ABO approach (a), from the modified V6 L3 products based on the ABD approach (V7 L3-like products) (b), and their difference (c). The monthly mean temperatures based on these two approaches are very similar. The pattern of positive and negative differences (V7-V6) alternates around the globe and varies with region and topography (land or ocean), which indicates that the day-to-day variations of count numbers due to the combination of the orbit shift and valid retrieval (or cloudy/clear sky impact) on the monthly means are complex and vary with region and season. The differences are larger in the high-latitude areas than in the low-latitude areas. More details regarding the impacts of these two averaging methods on the AIRS L3 products can be found in the following paper:

Ding, F., Savtchenko, A., Hearty, T. J., Wei, J., Theobald, M., Vollmer, B., Tian, B. J., & Fetzer, E. J. (2020), Assessing the Impacts of Two Averaging Methods on AIRS Level 3 Monthly Products and Multi-year Monthly Means, *J. Atm. Oc. Tech.*, **37**, https://doi.org/10.1175/JTECH-D-19-0129.

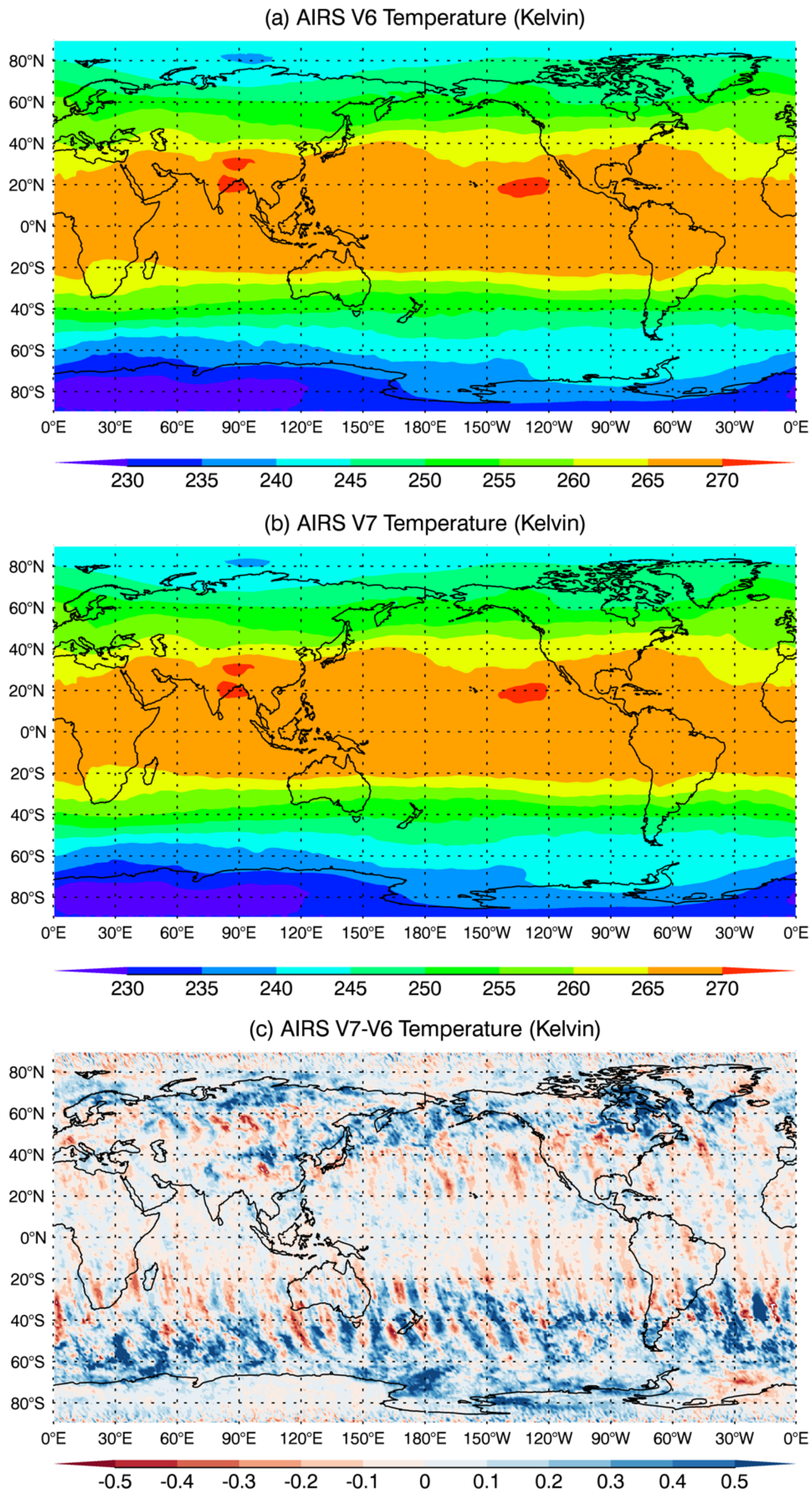


Figure 6. The AIRS L3 monthly mean temperature at 500 hPa for September 2002 from the standard V6 L3 products based on the ABO approach (a), from the modified V6 L3 products based on the ABD approach (V7 L3-like products) (b), and their differences (c).

5.2. Remove Less Used Ancillary Fields

For the AIRS V6 L3 product, there are also up to 5 ancillary fields to complement each retrieval mean (without any suffix): standard deviation (with a suffix of _sdev), minimum (with a suffix of _min), maximum (with a suffix of _max), input count (with a suffix of _ct), and standard error (with a suffix of _err). For the AIRS V7 L3 product, there are only 2 ancillary fields to complement each retrieval mean (without any suffix): input count (with a suffix of _ct) and standard deviation (with a suffix of _sdev). This has significantly reduced the file size of the AIRS V7 L3 products.

5.3. Remove Less Used 8-Day Product

For the AIRS V6 L3 product, there are three temporal resolutions: daily, 8-day (half of the 16-day Aqua orbit repeat cycle) and monthly (calendar). In contrast, there are only two temporal resolutions: daily and monthly (calendar) for the AIRS V7 L3 product. The less-used 8-day L3 product has been removed from the V7.

5.4. Remove Less Used L3 Quant Product

For the AIRS V6 L3 product, there is a 5°x5° L3 quantized product (L3Q) that summarizes mean, standard deviation and number of observations on a 5x5 degree grid per pentad (5 days) and calendar month for up to 100 clusters at 10 pressure levels. Day and night data is mixed together. For the AIRS V7 L3 product, this 5°x5° L3 quantized product (L3Q) has been removed due to its infrequent usage. This has significantly reduced the file size of the AIRS V7 L3 products.

5.5. Remove Total Column CO and CH4 and Surface O3, CO and CH4 Products

The peak sensitivity of the AIRS retrieval to carbon monoxide (CO) occurs at 500 hPa and the peak sensitivity of the AIRS retrieval to methane (CH4) occurs at 300 hPa. AIRS has no skill in retrieving the CO and CH4 surface amounts, and the information we report on the total column CO and CH4 comes almost entirely from the climatology used in the first guess. For these reasons we have removed the total column and surface CO and CH4 reported in the V6 L3 product from the V7 L3 product. Only the mid-tropospheric CO and CH4 mixing ratios are kept in the V7 L3 product. Similarly, AIRS has no skill in retrieving the ozone (O3) surface amounts and we have removed the surface O3 reported in the V6 L3 product from the V7 L3 product.